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EVALUATION OF THREE TYPES OF TECHNICAL DATA FOR TROUBLESHOOTING--ETC(U)
SEP 76 N R POTTER, P R HUBBERT, J V LANDOLFI F33615-75-C-5103
AFHRL-TR-76-74(3) NL

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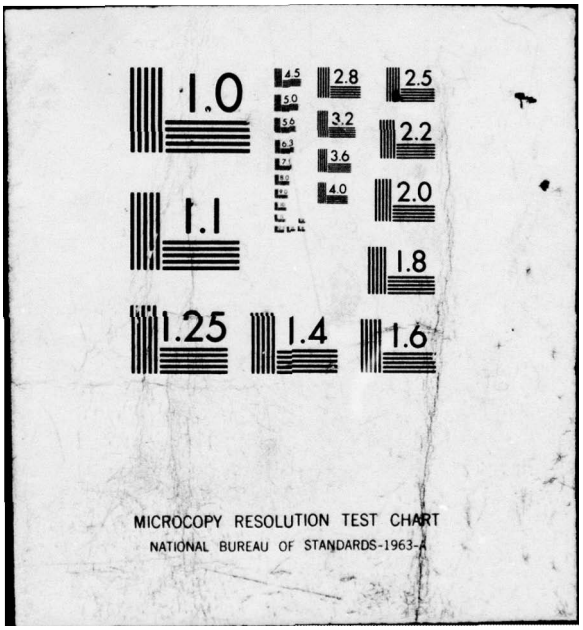
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AIR FORCE HUMAN RESOURCES LABORATORY

EVALUATION OF THREE TYPES OF TECHNICAL DATA FOR TROUBLESHOOTING:

TEST ADMINISTRATOR'S GUIDE

By

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Wright-Patterson Air Force Base, Ohio 45433

September 1976
Final Report for Period 13 January 1975 – 15 September 1976

AIR FORCE SYSTEMS COMMAND
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This final report was submitted by Systems Research Laboratories, Incorporated, 2800 Indian Ripple Road, Dayton, Ohio 45440, under contract F33615-75-C-5103, project 1194, with Advanced Systems Division, Air Force Human Resources Laboratory (AFSC), Wright-Patterson Air Force Base, Ohio 45433. Dr. Donald L. Thomas, Personnel and Training Requirements Branch, was the contract monitor.

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This technical report has been reviewed and is approved.

GORDON A. ECKSTRAND, Director
Advanced Systems Division

Approved for publication.

DAN D. FULGHAM, Colonel, USAF
Commander

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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: AFHRL-TR-76-74(I)	2. GOVT ACCESSION NO. / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): EVALUATION OF THREE TYPES OF TECHNICAL DATA FOR TROUBLESHOOTING: TEST ADMINISTRATOR'S GUIDE,	5. TYPE OF REPORT & PERIOD COVERED: Final rept. Jan 75 – Sep 76 / 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Norman R. Potter, P. Richard Hubbert, James V. Landolfi, Daniel L. Rice, Ned H. Kearns	8. CONTRACT OR GRANT NUMBER(s): F33615-75-C-5103
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Systems Research Laboratories, Inc., 2800 Indian Ripple Road, Dayton, Ohio 45440	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 63102F, 11940004
11. CONTROLLING OFFICE NAME AND ADDRESS: HQ Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235	12. REPORT DATE: Sep 76 / 13. NUMBER OF PAGES: 199 (12) 188p.
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*: Advanced Systems Division, Air Force Human Resources Laboratory, Wright-Patterson Air Force Base, Ohio 45433	15. SECURITY CLASS. *(of this report)*: Unclassified / 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

fully proceduralized troubleshooting aids
job performance tests
job task performance test
logic tree troubleshooting aids
performance evaluation
performance tests
technical data evaluation
technical orders

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This volume contains a guide for the administration of job performance tests used in a study to evaluate the effectiveness of three types of technical data for troubleshooting. The performance tests measure the ability of technicians to troubleshoot 15 typical malfunctions in the AN/APN-147 doppler radar and AN/ASN-35 navigational computer. The tests are specifically designed to measure performance using the three types of data – fully proceduralized troubleshooting aids, logic tree troubleshooting aids and conventional technical orders. Three forms are provided for each test, one for each type of technical data. Guidance is provided for the pretest setup, test administration, and performance evaluation. The complete evaluation project is described in AFHRL-TR-76-74(I).

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Unclassified

Test Administrator's Guide

October 1976

Air Force Human Resources Laboratory
Wright-Patterson AFB, Ohio 45433

SUMMARY

PURPOSE

The purpose of the project described in this report was to conduct an evaluation comparing fully proceduralized troubleshooting aids (FPTAs), logic tree troubleshooting aids (LTTAs), and technical orders (TOs) in terms of

1. The costs involved in developing each type of aid
2. The technical accuracy of each type of data
3. The effectiveness of each type of data for supporting maintenance personnel of varying experience levels in performing troubleshooting tasks.

METHOD

Cost comparison: The available data on costs to produce each of the three types of technical data were obtained from FPTA and LTTA contractors, and from the Air Force Logistic Centers responsible for TO procurement. Due to differences in coverage, developer experience, data base and types of systems for which the technical data were developed, difficulty was experienced in arriving at a single measure which would permit a meaningful comparison of the three document types. The approach selected was to base the analysis on the cost to produce a page unit. A page unit was defined as a standard 8-1/2 by 11 inch format. Use of this standard made it necessary to convert the 4 by 8 inch page format used in the LTTA checkout procedures for organizational level maintenance into the standard page unit. No other page conversions were required.

Technical accuracy: Review of worldwide Air Force maintenance actions was undertaken to provide identification of maintenance areas which could serve as representative candidates for development of troubleshooting test problems. A total of 30 specific troubleshooting test problems were selected which were distributed throughout the AN/APN-147 (radar) and AN/ASN-35 (computer) systems of the C-141A aircraft. Each problem was inserted into working system equipment. The effects on system operation were identified and a systematic evaluation of the accuracy of the technical documentation types in supporting the isolation of the faults was undertaken. Records were maintained on the errors found in the data and on whether the procedure led to isolation of the problem. Those faults which could be successfully isolated by each of the three types of technical data were retained for consideration as a test problem in the field data collection phase.

Experimental evaluation of effectiveness of each technical data type: Three experience levels of Air Force technicians in the Avionics

Inertial and Radar Navigational Systems Specialty (AFSC 328X4) served as subjects. The experience levels were: recent graduates of the technical training course (no field experience); technicians with less than six months experience on the equipment; and technicians with more than six months experience. Eighteen technicians at each experience level were used as subjects. A determination was made that it would not be appropriate to test the no experience group on technical orders. This decision made it necessary to use two different, but similar, experimental designs. Both designs involved repeated measures on subjects. In the first design, the no experience group was tested using two types of data, FPTAs and LTTAs. In the second design, the two experienced groups of subjects were tested using all three types of data. Data collection was accomplished at Keesler Technical Training Center and at three Military Airlift Command bases: McChord, Travis, and McGuire.

RESULTS

The cost comparison, primarily due to the fact that sufficient comparable data could not be assembled, produced inconclusive results. However, the available data did suggest that the costs of developing fully proceduralized troubleshooting aids in a newly developed system where all support data would also have to be generated may not be much different from the costs incurred in technical order development.

Errors in accuracy were found in both the FPTA and LTTA. The errors discovered vary in their impact on performance from negligible to completely disruptive. However, no accuracy errors were found that were considered beyond solution. Increased emphasis on quality control would eliminate most of the accuracy errors found.

The results of the experimental evaluation clearly demonstrate that the use of proceduralized troubleshooting aids results in significantly better troubleshooting than the use of the T.O. This finding held for two of the three measures: proportion of problems solved and spare parts consumed. For the third measure, time to troubleshoot, the use of TOs resulted in better performance at the organizational level but not at the intermediate level of maintenance.

In comparison of the FPTA against the LTTA, the FPTA was superior for the no experience group on all measures. For experienced technicians, use of the FPTA resulted in slightly better performance on all measures except time to troubleshoot at the organizational level.

In addition to the objective performance data, subjective opinion data of the technicians provided unqualified support for the use of the FPTA as the most favored of the three types of technical documentation.

The findings of this research effort support the following recommendations:

1. Consideration should be given to development of FPTAs or LTTAs for new procurements of technical data for trouble-shooting.
2. Strong emphasis should be placed on accuracy evaluation.
3. Additional analyses of the costs and cost benefits of FPTAs and LTTAs should be made.
4. The potential of FPTAs and LTTAs for reducing training costs should be evaluated.
5. Strong consideration should be given to modification of the LTTA format to include more of the proceduralization material contained in the FPTA.

This report is in three volumes: Volume I presents a summary of the project and the results. Volume II presents a detailed description of the experimental procedures used in the study. This volume presents the test administrator's guide. The guide provides instructions for administering and scoring the job performance tests used in the study.

PREFACE

This study was initiated by the Advanced Systems Division, Air Force Human Resources Laboratory (AFHRL), Wright-Patterson Air Force Base, Ohio. The research was performed by Systems Research Laboratories, Inc., Dayton, Ohio, under Contract F33615-75-C-5103, with Dr. Norman R. Potter as principal investigator.

The authors wish to express their appreciation to John J. Klesch, AFHRL, for his guidance and knowledgeable consultation throughout the project; to Dr. Donald L. Thomas and MSgt Bobby Spaulding, also of AFHRL, for their guidance, not only throughout the project, but especially during the selection and verification of troubleshooting problems and compilation of this guide; and to Dennis Scott and Gerald Podgornik of Applied Sciences Associates, Inc., Valencia, Pennsylvania, for the assistance they provided during the problem selection and verification tasks.

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TEST ADMINISTRATOR'S GUIDE

INTRODUCTION

The purpose of this effort was to collect data on which to base objective decisions about the relative merits of two new types of technical documentation in comparison to the standard Air Force technical order (TO). The major emphasis of this effort entailed the collection of data through the design and conduct of a carefully controlled systematic experimental evaluation of troubleshooting performance incorporating the use of the three types of technical documentation to guide technical activities.

Distinct advantages have been claimed for the use of technical documentation other than Air Force TOs; however, little empirical data can be found to support, or refute, these claims. This study was designed to supply objective data on which the merits of fully proceduralized troubleshooting aids (FPTAs) and logic tree troubleshooting aids (LTTAs) in comparison with TOs could be weighed.

The specific objectives of the experimental evaluation were to obtain data which could permit answers to the following questions:

1. Does quality of performance with the three types of documentation depend upon experience level of the technician?

2. Does FPTA performance differ from LTTA performance? Are both FPTA and LTTA performance different from TO performance?

3. Is there an interaction between type of technical data and level of experience? If so, what is the nature of the interaction?

4. Does performance with the three types of technical documentation differ for organizational and intermediate level maintenance troubleshooting?

5. Is there an interaction between level of maintenance troubleshooting and level of experience? If so, what is the nature of the interaction?

6. Is there an interaction between FPTA or LTTA technical data and level of maintenance troubleshooting? If so, what is the nature of the interaction?

7. Is there an interaction among types of technical documentation experience level and level of maintenance troubleshooting? If so, what is the nature of the interaction?

As a preliminary step in the evaluation of the three types of technical documentation for troubleshooting Air Force equipment, each of the data types was subjected to an empirical demonstration of its accuracy in permitting the isolation of equipment problems.

The equipment problems against which the documentation types were evaluated were selected after an intensive review of worldwide Air Force maintenance actions on the AN/APN-147 and AN/ASN-35 systems for calendar year 1974. The source of the maintenance action data was Air Force Logistics Command reports RCS: LOG-MMO(AR)7167 and LOG-MMO(AR) 7168. The data contained in these reports were summarized to provide identification of maintenance areas which appeared to be logical and representative candidates for development of troubleshooting test problems. In an attempt to provide field verification of the correctness of the data summarizations, the results were discussed in detail with maintenance personnel at Charleston AFB, South Carolina. (This base was not included in the field evaluation effort.) As a result of the Charleston AFB interviews, detailed information, not available from the AFLC reports, was obtained on the specific parts or components which were contributing most to the maintenance problems of the AN/APN-147 and the AN/ASN-35. This information was considered in selecting the specific troubleshooting test problems. A total of 30 malfunctions selected was located on an applicable system schematic to verify that the problems selected were satisfactorily distributed throughout the system.

Each of the candidate problems was investigated in working equipment to catalog the operational symptoms associated with the failed equipment part or component. Once the known effects of the fault had been identified, a systematic evaluation of the accuracy of each of the technical documents in supporting the isolation of the faults was undertaken. This evaluation was based on actual troubleshooting performance on powered equipment using each of the document types as the guiding document for fault isolation. The approach just described made use of the same (primary and test) equipment and aids as used in the field evaluation portion of the experiment.

Certain problems had to be substituted to assure compatibility with the degree of simulation fidelity employed in the Air Force simulations of a C-141A cockpit and intermediate (shop) level maintenance benches. As an example, the technical documentation guiding isolation of certain of the faults originally selected directed the troubleshooter to the Horizontal Situation Indicator (HSI). The HSI was represented by a nonfunctioning simulation in the Air Force trailer; thus, the particular fault could not be resolved by the technical documentation/equipment simulation combination. In an instance such as

this, a new candidate fault was selected and the ability of the types of technical documentation to find it was verified. Any editorial or content problem with the candidate types of technical documentation discovered as a result of following this process was reported to the Air Force technical monitor for correction.

Eighteen airmen graduates of Keesler Technical Training Center (KTTC) Course No. 3ABR32834 served as one of the three subject groups. Subjects were first enlistment airmen who had completed basic training and who went directly into technical training at KTTC. The airmen were retained at Keesler for a two-week period beyond course graduation and entered as subjects in this experiment.

The two remaining subject groups in the design were obtained from Air Force enlisted personnel in the 328X4 AFSC, "Avionics Inertial and Radar Navigational Systems Specialist," assigned to operational units of the Military Airlift Command (MAC) and performing maintenance on the AN/ASN-35 and AN/APN-147 systems in C-141A aircraft.

These two groups were classified on the basis of length of experience with the C-141A equipment. Each group has a size of n=18. One group consisted of airmen with six months or less equipment experience on the system; the second group, airmen with more than six months experience on the system. Three MAC bases were visited to obtain the required number of subjects. Each airman selected as a subject was made available for a two-week period. During this period, the airmen continued to work their normal shifts and served as subjects for a four-hour period out of each eight-hour shift.

An Air Force trailer configured to include AN/ASN-35 (computer) and AN/APN-147 (radar) bench mock-ups and a mock-up of the C-141A cockpit comprised the main experimental apparatus. In addition to this, a number of items of test equipment were available for use with the prime equipment.

Job performance tests were developed to measure the technician's ability to troubleshoot 15 problems. Performance was measured by inserting faults into the equipment and observing the technician's performance in isolating the fault. This Test Administrator's Guide (TAG) provides detailed instructions for administering each test. It includes procedures for problem setup, performance observation, and performance evaluation. Test administration instructions are designed to provide standard procedures for each problem and each subject.

Three separate test administrator's guides are provided for each problem, one for each type of data. Each TAG is divided into eight sections. The necessary actions to be performed prior to subject participation are included in sections I through V. The sections of the TAS are summarized below:

Section I. Problem number and a general description of the location of the problem (line replaceable unit, subassembly, or component).

Section II. Time Limit. One hour for all problems.

Section III. Pretest Setup. Descriptions of procedures to be used by the experimenter in initial problem installation.

Section IV. Support Materials Required. Listing of all materials and equipment needed for solving the problem.

Section V. General Instructions. Instructions and procedures for the experimenter before the subject is introduced to the problem.

Section VI. Troubleshooting Procedure. A "roadmap" for the experimenter. Using this section, the experimenter can follow the subject's progress and be alerted to any procedural errors.

Section VII. Evaluation Method. The data collection form.

Section VIII. Post-Test Recovery. Procedures for returning the equipment to normal operating conditions after the problem has been run.

To provide an initial introduction to the nature of the project, each subject was supplied with a copy of the letter appearing as Figure 1. This letter briefly states the project's purpose, its goal, the basic methods of execution and the expected impact of the results.

Before a subject was introduced to a problem he was asked to read the following instructions:

INFORMATION AND INSTRUCTIONS

Evaluation of Different Types of Technical Data for Troubleshooting

You have been asked by the Air Force to help them in providing answers to a number of very important questions about the suitability of two new types of technical data for equipment maintenance and troubleshooting.

The Air Force is interested in providing manuals which assist the technician in his desire to do the best possible job of equipment maintenance. However, without your help, the Air Force will not have the information it needs to make a correct decision about the merits of each of the proposed documents.

DEPARTMENT OF THE AIR FORCE
AFHRL ADVANCED SYSTEMS DIVISION (AFSC)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

REPLY TO ATTN OF: AFHRL/AS

SUBJECT: Participation in Technical Data Evaluation Project

TO:

1. You and other members of your organization have been selected to participate in a project being conducted by the Air Force Human Resources Laboratory to evaluate the effectiveness of two new types of technical orders for use in troubleshooting electronic equipment. The evaluation project will provide information needed by the Air Force for determining what type of technical orders to procure for new and existing Air Force weapons systems.

2. The goal of the evaluation is to determine how well each type of T.O. meets the technician's needs for troubleshooting information. As part of the evaluation, you will be asked to work on the AN/APN-147 radar system and the AN/ASN-35 computer system in a controlled environment. Work on the systems requires the use of several specific items of test equipment. Since you may not be familiar with some of the test equipment or may not have used it for a long time, refresher training will be provided as needed. Following the training, you will be asked to troubleshoot several malfunctions in the system.

3. As you work, you will be observed to determine if the T.O. has provided you with effective procedures presented with sufficient detail and clarity to permit you to successfully isolate the cause of the malfunction. Remember, this will be a test of the effectiveness of the experimental technical orders and not a test of your skill as a technician. The data being collected are for research purposes only. No test information will become a part of your record or will effect your future promotions or assignments in any way.

4. The results of this evaluation are expected to have an important impact on future changes in the Air Force Technical Order system. Your participation will make a significant contribution to improving Air Force Technical Orders.

Edward A Cope

EDWARD A. COPE, Lt. Col., USAF
Deputy Director

Figure 1. Introductory Letter

For this reason, you are being asked to use each of the documents in troubleshooting a series of carefully selected equipment problems.

You are being asked to work on these problems in a closely controlled experimental evaluation. In brief, the Air Force is asking you to be an experimental subject in its field evaluation of the technical data. For this reason, it is important that you follow all instructions given you.

One way of comparing the merits of different types of technical manuals is to find out how long it takes to correctly isolate an equipment problem using a particular document.

Attempts have been made to select problems which can be located within an hour of troubleshooting. To find out if our estimates are correct, time required to solve each problem will be recorded. We would like to emphasize that we are NOT interested in finding out how quickly YOU can solve the problem; we want to know the length of time it takes the proposed technical document to guide you to the correct solution. YOU ARE NOT BEING TESTED -- THE DOCUMENT IS!

After reading these general instructions, the subject was given a sheet of specific instructions. These instructions are reproduced below:

SPECIFIC INSTRUCTIONS

1. Approximately one hour is allocated to each troubleshooting problem.

2. The technical document you are using is intended to be self-explanatory. If you have a problem, read the item in question again. If after repeating the item you still have a problem, then ask the experimenter.

3. Notify the experimenter of any decisive steps (removal of parts or branching from steps) BEFORE making them.

4. Tools not furnished will be supplied upon request if required.

5. When time is started, you are to turn this page, read the work order given, and begin the troubleshooting procedures.

6. Manuals for the test equipment are available for you to use if necessary.

7. During this exercise, observe all of the standard safety procedures.

8. The experimenter will inform you when the time is over.

DO NOT TURN THIS PAGE UNTIL INSTRUCTED
TO DO SO BY THE EXPERIMENTER

Upon turning the page, each subject was confronted with a work order describing the particular problem to be located. The same work order is used for a problem regardless of the type of documentation being followed. For this reason, in all instances in this document, the work order is presented once for each problem, and is located at the end of the section on each problem.

TEST

ADMINISTRATOR'S

GUIDE

I. Problem No. 1: Radar Cockpit - Drift Motor B03 in Antenna.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Check that settings on radar and computer test harness are set according to chart (pg 3).

b) Check that plugs are securely fastened to indicators' connectors behind the console.

c) Open all circuit breakers on avionics panel.

d) Set antenna to zero drift angle.

e) Set switches on navigator console indicators to OFF and bulbs to full left turn.

f) Turn off lights on experimenter's panel.

g) Problem insertion.

1) Remove cover from antenna.

2) Find motor B03 top middle area and disconnect the wire from connection No. 4. Replace cover on antenna.

IV. Supported Materials Required

a) Cockpit mock-up of C-141 aircraft with working doppler radar and computer.

b) Stopwatch - 2

c) Tool kit, including fuses, bulbs, and jumper wires

d) Doppler simulator

e) VOM, Simpson-260 or PSM-6

f) Spare radar control set

g) FPTA - T.O. 12P5-2APN147-TS-1

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) Answer any questions, then tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) Follow the subject's procedures and fill out evaluation sheet during the test.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section I (pg 1-1).

b) Start checkout at Step 1 (pg 1-3).

c) Fault Symptom: On Step 12 (pg 1-3) antenna will not drift.

d) Go to Malfunction No. 4 (pg 1-10). Start at Step 1.

e) Note: On Step 3, S should replace control set and continue.

f) Note: On Step 10 simulator already removed in Step 6. Also there are no jumper wires from P30E. Ohm reading not correct --replace antenna. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on console.

b) Open all circuit breakers on avionics panel.

c) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

d) Replace and remove parts.

PROBLEM NO. 1. Radar Cockpit

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Prepare for checkout					
Check memory warning lights					
Check G/S slewing					
Check DR slewing					
Troubleshoot malfunction No. 4					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 1: Radar Cockpit - Drift Motor B03 in Antenna.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Check that settings on radar and computer test harness are set according to chart (pg 3).

b) Check that plugs are securely fastened to indicators' connectors behind the console.

c) Open all circuit breakers on avionics panel.

d) Set antenna to zero drift angle.

e) Set switches on navigator console indicators to OFF and bulbs to full left turn.

f) Turn off lights on experimenter's panel.

g) Problem insertion.

1) Remove cover from antenna.

2) Find motor B03 top middle area and disconnect the wire from connection No. 4. Replace cover on antenna.

IV. Support Materials Required

a) Cockpit mock-up of C-141 aircraft with working doppler radar and computer

b) Stopwatch - 2

c) Tool kit, including fuses and bulbs

d) Doppler simulator

e) VOM, Simpson-260 or PSM-6

f) LTTA - T.O. 1C-141A-2-8JG-2 and T.O. 1C-141A-2-8TS-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) Answer any questions, then tell S, "You may now turn the top sheet over, read the work order and BEGIN trouble-shooting procedures." Start stopwatch when subject turns the page.

d) Follow the subject's procedures and fill out evaluation sheet during the test.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

f) Tell S that the experimenter will serve as man "B".

VI. Troubleshooting Procedure

a) Start at Step 1 (pg 1-11) on System Check.

b) Fault Symptom: On Step 3 (pg 1-11) antenna will not drift.

c) Go to Troubleshooting Manual, pg 18-1.

d) Branch to Malfunction No. 18-9 (pg 18-8) where subject should say to replace antenna. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on console.

b) Open all circuit breakers on avionics panel.

c) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedures.

d) Replace and remove parts.

PROBLEM NO. 1. Radar Cockpit

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
System check					
No indicator response with DR switch in left or right--memory warning lights out					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 1: Radar Cockpit - Drift Motor B03 in Antenna.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Check that settings on radar and computer test harness are set according to chart (pg 4).

b) Check that plugs are securely fastened to indicators' connectors behind the console.

c) Open all circuit breakers on avionics panel.

d) Set antenna to zero drift angle.

e) Set switches on navigator console indicators to OFF and bulbs to full left turn.

f) Turn off lights on experimenter's panel.

g) Problem insertion.

1) Remove cover from antenna.

2) Find motor B03 top middle area and disconnect the wire from connection No. 4. Replace cover on antenna.

IV. Support Materials Required

a) Cockpit mock-up of C-141 aircraft with working doppler radar and computer

b) Stopwatch - 2

c) Tool kit, including fuses and bulbs

d) 410B VTVM Vacuum Tube Voltmeter

e) 260 VOM Volt Ohmmeter

f) 545B Oscilloscope

g) 5245L Electronic Counter and Plug-Ins

h) TV2 Tube Tester

i) TS-148 Radar Test Set

j) 803 Differential VTVM

k) 200CD Audio Oscillator

l) URM-25D Signal Generator

m) TS-1100/U Test Set, Transistor

n) CMA-544 Doppler Simulator

o) CMA-546 Doppler Generator

p) 3322-900 Computer Cards Tester

q) 3322-902 Computer Drives Tester

r) 3322-905 Navigational Tester

s) 3322-901 Tester Computer Relay Chassis

t) SG-299 B/U Signal Generator

u) Kay Sweep Generator

v) T.O.: 1C-141A-2-8

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) Answer any questions, then tell S, "You may now turn the top sheet over, read the work order and BEGIN trouble-shooting procedures." Start stopwatch when subject turns the page.

d) Follow the subject's procedures and fill out evaluation sheet during the test.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

f) Tell S that the experimenter will serve as man "B".

VI. Troubleshooting Procedure

a) Start at Section XV (pg 15-1), then go to Operational Checkout on pg 15-4 (change 12).

b) Fault Symptom: On Step 15-9/d antenna will not drift.

c) Go to Troubleshooting section 15-7.

d) When subject finds solution, end the test. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on console.

b) Open all circuit breakers on avionics panel.

c) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

d) Replace and remove parts.

PROBLEM NO. 1. Radar Cockpit

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

Setup Conditions for Computer and Radar Test Harness Panel

Wires connecting: B15 & B5, B4 & E10, E6 & D16, E7 & D15, E11 & E16

Settings:

115 Vac - ON

Drift Angle - ON

Comp. Reference Track - IN

Heading Track Simulator - IN

Smooth Sea - OFF

28 Vdc - ON

115 V 400 cps - ON

28 Vdc - ON

26 Vac Exc - Int

Terrain Switch - Land

Synchro Zero - Rough Zero

Synchro Selector - OFF

Reference Synchro - Zero

Meter -Δ115V 400 cps

I.F. Gain - Full to Right

Test - OFF

Signal Selector - OFF

WORK ORDER

Troubleshoot malfunctioning AN/APN-147 Radar System.

I. Problem No. 2: Computer Cockpit - Relay K4402 in Aux. Cross Track Indicator.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Check that settings on radar and computer test harness are set according to chart (pg 3).

b) Check that plugs are securely fastened to indicators' connectors behind the console.

c) Open all circuit breakers on avionics panel.

d) Set antenna to zero drift angle.

e) Set switches on navigator console indicators to OFF and bulbs to full left turn.

f) Turn off lights on experimenter's panel.

g) Insert problem.

1) Unplug auxiliary cross track indicator from connecting cable behind console and remove it from console.

2) Remove dust cover from indicator.

3) Remove cover from relays inside indicator.

4) Remove relay K4402 and replace with bad one.

5) Replace relay cover and dust cover and indicator back into console.

6) Reconnect plug behind console to indicator.

IV. Support Materials Needed

a) Mock-up of C-141A aircraft, cockpit, including working doppler radar and computer.

b) Stopwatch - 2

c) Tool kit with fuses and bulbs

d) Doppler simulator

e) VOM, Simpson-260 or PSM-6

f) FPTA - T.O. 5N1-3-TS-1

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) Answer any questions, then tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) Follow the subject's procedures and fill out evaluation sheet during the test.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section I (page 1-1).

b) Start checkout at Step 1 (page 1-4).

c) Fault Symptom: On Step 51 (page 1-7) Auxiliary Cross Track Indicator does not count.

d) On Step 51-B (page 1-7) subject should say to replace Auxiliary Cross Track Indicator. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on console.

b) Open all circuit breakers on avionics panel.

c) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

d) Replace and remove parts.

PROBLEM NO. 2. Computer Cockpit

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Prepare for checkout					
Perform checkout					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 2: Computer Cockpit - Relay K4402 in Aux. Cross Track Indicator.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Check that settings on radar and computer test harness are set according to chart (pg 3).

b) Check that plugs are securely fastened to indicators' connectors behind the console.

c) Open all circuit breakers on avionics panel.

d) Set antenna to zero drift angle.

e) Set switches on navigator console indicators to OFF and bulbs to full left turn.

f) Turn off lights on experimenter's panel.

g) Insert problem.

1) Unplug auxiliary cross track indicator from connecting cable behind console and remove it from console.

2) Remove dust cover from indicator.

3) Remove cover from relays inside indicator.

4) Remove Relay K4402 and replace with bad one.

5) Replace relay cover and dust cover and indicator back into console.

6) Reconnect plug behind console to indicator.

IV. Support Materials Needed

a) Mock-up of C-141A aircraft, cockpit, including working doppler radar and computer.

b) Stopwatch - 2

c) Tool kit with fuses and bulbs

d) Doppler simulation

e) VOM, Simpson-260 or PSM-6

f) LTTA - TO 1C-141A-2-8J6-2 and TO 1C-141A-2-8TS-1

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) Answer any questions, then tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting Procedures." Start stopwatch when subject turns the page.

d) Follow the subject's procedures and fill out evaluation sheet during the test.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Step 1 (page 3-2).

b) Note: Tell subject to disregard any readings of HSI indicator.

c) Subject should finish minimum check and start detailed check on page 3-11.

d) Fault symptom: On Step 21 (page 3-13) auxiliary cross track indicator will not decrease.

e) Go to Malfunction Handbook (page 19-1) and find listing of malfunction.

f) Go to Malfunction No. 19-8 (page 19-7). Subject should say to replace auxiliary indicator. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on console.

b) Open all circuit breakers on avionics panel.

c) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

d) Replace and remove parts.

PROBLEM NO. 2. Computer Cockpit

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Minimum performance check					
Detailed performance check					
Aux. Cross Track will not count left or right in Stage 1					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 2: Computer Cockpit - Relay K4402 in Aux. Cross Track Indicator.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Check that settings on radar and computer test harness are set according to chart (pg 4).

b) Check that plugs are securely fastened to indicators' connectors behind the console.

c) Open all circuit breakers on avionics panel.

d) Set antenna to zero drift angle.

e) Set switches on navigator console indicators to OFF and bulbs to full left turn.

f) Turn off lights on experimenter's panel.

g) Insert problem.

1) Unplug auxiliary cross track indicator from connecting cable behind console and remove it from console.

2) Remove dust cover from indicator.

3) Remove cover from relays inside indicator.

4) Remove Relay K4402 and replace with bad one.

5) Replace relay cover and dust cover and indicator back into console.

6) Reconnect plug behind console to indicator.

IV. Support Materials Needed

a) Mock-up of C-141A aircraft, cockpit, including working doppler radar and computer.

b) Stopwatch - 2

c) Tool kit with fuses and bulbs

d) 410B VTVM Vacuum Tube Voltmeter

e) 260 VOM Volt Ohmmeter

f) 545B Oscilloscope

g) 5245L Electronic Counter and Plug-Ins

h) TV2 Tube Tester

i) TS-148 Radar Test Set

j) 803 Differential VTVM

k) 200CD Audio Oscillator

l) URM-25D Signal Generator

m) TS-1100/U Test Set, Transistor

n) CMA-544 Doppler Simulator

o) CMA-546 Doppler Generator

p) 3322-900 Computer Cards Tester

q) 3322-902 Computer Drives Tester

r) 3322-905 Navigational Tester

s) 3322-901 Tester Computer Relay Chassis

t) SG-299 B/U Signal Generator

u) Kay Sweep Generator

v) TO 1C-141A-2-8

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) Answer any questions, then tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) Follow the subject's procedures and fill out evaluation sheet during the test.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section XVI (pg 16-1), then go to Operational Checkout, pg 16-3 (change 12).

b) Fault Symptom: On Step 16-8/j, auxiliary cross track does not count.

c) Go to Troubleshooting section 16-9.

d) When subject finds correct problem auxiliary indicator, end the test. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on console.

b) Open all circuit breakers on avionics panel.

c) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

d) Replace and remove parts.

PROBLEM NO. 2. Computer Cockpit

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: |_|Yes |_|No

Remarks:

Setup Conditions for Computer and Radar Test Harness Panel

Wires connecting: B15 & B5, B4 & E10, E6 & D16, E7 & D15, E11 & E16

Settings:

115 Vac - ON

Drift Angle - ON

Comp. Reference Track - IN

Heading Track Simulator - Int

Smooth Sea - OFF

28 Vdc - ON

115 V 400 cps - ON

28 Vdc - ON

26 Vac Exc - Int

Terrain Switch - Land

Synchro Zero - Rough Zero

Synchro Selector - OFF

Reference Synchro - Zero

Meter -Δ115V 400 cps

I.F. Gain - Full to Right Test - OFF Signal Selector - OFF

WORK ORDER

Troubleshoot malfunctioning AN/ASN-35 Navigational Computer.

I. Problem No. 3: Radar Cockpit - Klystron V6201 in Receiver-Transmitter.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Check that settings on radar and computer test harness are set according to chart (pg 3).

b) Check that plugs are securely fastened to indicators' connectors behind the console.

c) Open all circuit breakers on avionics panel.

d) Set antenna to zero drift angle.

e) Set switches on navigator console indicators to OFF and bulbs set to full left turn.

f) Turn off lights on experimenter's panel.

g) Insert problem.

1) Remove receiver-transmitter (R-T) unit from behind mock-up.

2) Remove cover on R-T unit and locate transmitter subassembly.

3) Remove Klystron V6201 on transmitter subassembly and replace with defective one.

4) Reinstall cover of R-T unit and replace in position behind mock-up.

IV. Support Materials Required

a) Mock-up of aircraft C-141A cockpit, including working doppler radar and computer.

b) Stopwatch - 2

c) Tool kit, including fuses and bulbs

d) Doppler simulator

e) VOM, Simpson-260 or PSM-6

f) Spare radar set control

g) FPTA: TO 12P5-2APN147-TS-1

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) Answer any questions, then tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) Follow the subject's procedures and fill out evaluation sheet during the test.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section I, page 1-1.

b) Start checkout at Step 1 (page 1-3).

c) Fault Symptom: Step 21 - peak reading cannot be obtained.

d) Go to Malfunction No. 8 (page 1-16).

e) Note: On Step 3, pin J6601-14 is +500 Vdc and J6601-1 is dc ground.

f) Note: On Step 4, pin J6601-16 is -425 Vdc and J6601-1 is dc ground. Tolerance should be ±5 Vdc.

g) Problem solved on Step 6. Bench checkout not needed. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on console.

b) Open all circuit breakers on avionics panel.

c) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

d) Replace and remove parts.

PROBLEM NO. 3. Radar Cockpit

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Prepare for checkout					
Checkout memory warning lights					
Check G/S slewing					
Check DR slewing					
Check pretakeoff switch					
Malfunction No. 8					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 3: Radar Cockpit - Klystron V6201 in Receiver-Transmitter.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Check that setting on radar and computer test harness are set according to chart (pg 3).

b) Check that plugs are securely fastened to indicators' connectors behind the console.

c) Open all circuit breakers on avionics panel.

d) Set antenna to zero drift angle.

e) Set switches on navigator console indicators to OFF and bulbs to full left turn.

f) Turn off lights on experimenter's panel.

g) Insert problem.

1) Remove receiver-transmitter (R-T) unit from behind mock-up.

2) Remove cover on R-T unit and locate transmitter subassembly.

3) Remove Klystron V6201 on transmitter subassembly and replace with defective one.

4) Reinstall cover of R-T unit and replace in position behind mock-up.

IV. Support Materials Required

a) Mock-up of aircraft C-141A cockpit, including working doppler radar and computer.

b) Stopwatch - 2

c) Tool kit, including fuses and bulbs

d) Doppler simulator

e) VOM, Simpson-260 or PSM-6

f) Spare radar set control

g) LTTA: TO 1C-141A-2-8JG-2 and T.O. 1C-141A-2-8TS-1

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) Answer any questions, then tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) Follow the subject's procedures and fill out evaluation sheet during the test.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Step 1 (pg 1-11) on System Check.

b) Fault Symptom: On Step 16 (pg 1-13) maximum deflection not obtained.

c) Refer to Troubleshooting Manual (pg 18-1).

d) Go to Malfunction 18-16 (pg 18-12).

e) Refer to Malfunction 18-17 (pg 18-13) where subject should replace R-T unit. Problem solved. Test ends. Stop timer. Dismiss Subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on console.

b) Open all circuit breakers on avionics panel.

c) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

d) Replace and remove parts.

PROBLEM NO. 3. Radar Cockpit

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
System check					
18-16 Test set tuning meter does not respond to system output signal					
18-17 Tracker test meter reads abnormal in XTALA and XTALB positions					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 3: Radar Cockpit - Klystron V6201 in Receiver-Transmitter.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Check that setting on radar and computer test harness are set according to chart (page 4).

b) Check that plugs are securely fastened to indicators' connectors behind the console.

c) Open all circuit breakers on avionics panel.

d) Set antenna to zero drift angle.

e) Set switches on navigator console indicators to OFF and bulbs to full left turn.

f) Turn off lights on experimenter's panel.

g) Insert problem.

1) Remove receiver-transmitter (R-T) unit from behind mock-up.

2) Remove cover on R-T unit and locate transmitter subassembly.

3) Remove Klystron V6201 on transmitter subassembly and replace with defective one.

4) Reinstall cover of R-T unit and replace in position behind mock-up.

IV. Support Materials Required

a) Mock-up of aircraft C-141A cockpit, including working doppler radar and computer.

b) Stopwatch - 2

c) Tool kit, including fuses and bulbs

d) 410B VTVM Vacuum Tube Voltmeter

e) 260 VOM Volt Ohmmeter

f) 545B Oscilloscope

g) 5245L Electronic Counter and Plug-Ins

h) TV2 Tube Tester

i) TS-148 Radar Test Set

j) 803 Differential VTVM

k) 200CD Audio Oscillator

l) URM-25D Signal Generator

m) TS-1100/U Test Set, Transistor

n) CMA-544 Doppler Simulator

o) CMA-546 Doppler Generator

p) 3322-900 Computer Cards Tester

q) 3322-902 Computer Drives Tester

r) 3322-905 Navigational Tester

s) 3322-901 Tester Computer Relay Chassis

t) SG-299 B/U Signal Generator

u) Kay Sweep Generator

v) TO 141A-2-8

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) Answer any questions, then tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) Follow the subject's procedures and fill out evaluation sheet during the test.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section XV (pg 15-1), then go to Operational Checkout, pg 16-3 (change 12).

b) Fault Symptom: On Step 15-9/j2, tuning meter will not peak.

c) Go to Troubleshooting section 15-13.

d) When subject finds solution, end the test. Stop timer. dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on console.

b) Open all circuit breakers on avionics panel.

c) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

d) Replace and remove parts.

PROBLEM NO. 3. Radar Cockpit

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

Setup Conditions for Computer and Radar Test Harness Panel

Wires connecting: B15 & B5, B4 & E10, E6 & D16, E7 & D15, E11 & E16

Settings:

115 Vac - ON

Drift Angle - ON

Comp. Reference Track - IN

Heading Track Simulator - Inc

Smooth Sea - OFF

28 Vdc - ON

115 V 400 cps - ON

28 Vdc - ON

26 Vac Exc - Int

Terrain Switch - Land

Synchro Zero - Rough Zero

Synchro Selector - OFF

Reference Synchro - Zero

Meter -Δ115V 400 cps

I.F. Gain - Full to Right Test - OFF Signal Selector - OFF

WORK ORDER

Troubleshoot malfunctioning AN/APN-147 Radar System.

I. Problem No. 4: Computer Cockpit - Transistor Q1603 on PNP Card.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Check that settings on radar and computer test harness are set according to chart (pg 3).

b) Check that plugs are securely fastened to indicators' connectors behind the console.

c) Open all circuit breakers on avionics panel.

d) Set antenna to zero drift angle.

e) Set switches on navigator console indicators to OFF and bulbs set to full left turn.

f) Turn off lights on experimenter's panel.

g) Insert problem.

1) Pull out computer assembly from behind console and remove cover.

2) Remove component boards restraining bar.

3) Remove PNP component board and replace with bad one.

4) Reinstall restraining bar and cover.

5) Put computer back behind console.

IV. Support Materials Required

a) Mock-up of aircraft C-141A cockpit, including working doppler radar and computer.

b) Stopwatch - 2

c) Tool kit, including fuses and bulbs

d) Doppler simulator

e) VOM, Simpson-260 or PSM-6

f) FPTA: TO 5N1-3-TS-1

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) Answer any questions, then tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures."

d) Follow the subject's procedures and fill out evaluation sheet during the test.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start on Section I (pg 1-1).

b) Start checkout on Step 1 (pg 1-4)

c) Fault Symptom: On Step 26, counter does not decrease.

d) Go to Malfunction No. 6 (pg 1-18)

e) On Step 9, subject should say to replace computer. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on console.

b) Open all circuit breakers on avionics panel.

c) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

d) Replace and remove parts.

PROBLEM NO. 4. Computer Cockpit

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Prepare for checkout					
Perform checkout					
Troubleshoot malfunction No. 6					

Testing Time: Test Finished Within Time: |_| Yes |_| No

Remarks:

I. Problem No. 4: Computer Cockpit - Transistor Q1603 on PNP Card.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Check that settings on radar and computer test harness are set according to chart (pg 3).

b) Check that plugs are securely fastened to indicators' connectors behind the console.

c) Open all circuit breakers on avionics panel.

d) Set antenna to zero drift angle.

e) Set switches on navigator console indicators to OFF and bulbs set to full left turn.

f) Turn off lights on experimenter's panel.

g) Insert problem.

1) Pull out computer assembly from behind console and remove cover.

2) Remove component boards restraining bar.

3) Remove PNP component board and replace with bad one.

4) Reinstall restraining bar and cover.

5) Put computer back behind console.

IV. Support Materials Required

a) Mock-up of aircraft C-141A cockpit, including working doppler radar and computer.

b) Tool kit with fuses and bulbs

c) Stopwatch - 2

d) LTTA: TO 1C-141A-2-8JG-2 and TO 1C-141A-2-8TS-1

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) Answer any questions, then tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures."

d) Follow the subject's procedures and fill out evaluation sheet during the test.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at minimum check (pg 3-2).

b) Fault Symptom: On Step 25 (pg 3-5) distance to go does not decrease.

c) Go to Troubleshooting Manual, pg 19-1, and find malfunction.

d) Go to Malfunction No. 19-4 (pg 19-4).

e) Note: Resistance reading between points TB8BS-319 and TB8BS-320 behind console is assumed to be less than 1 ohm.

f) Fault Symptom: Distance to go does not count up. Subject should say to replace computer. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on console.

b) Open all circuit breakers on avionics panel.

c) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

d) Replace and remove parts.

PROBLEM NO. 4. Computer Cockpit

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Minimum check (pg 3-2)					
Malfunction No. 19-4					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 4: Computer Cockpit - Transistor Q1603 on PNP Card.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Check that settings on radar and computer test harness are set according to chart (pg 4).

b) Check that plugs are securely fastened to indicators' connectors behind the console.

c) Open all circuit breakers on avionics panel.

d) Set antenna to zero drift angle.

e) Set switches on navigator console indicators to OFF and bulbs set to full left turn.

f) Turn off lights on experimenter's panel.

g) Insert problem.

1) Pull out computer assembly from behind console and remove cover.

2) Remove component boards restraining bar.

3) Remove PNP component board and replace with bad one.

4) Reinstall restraining bar and cover.

5) Put computer back behind console.

IV. Support Materials Required

a) Mock-up of aircraft C-141A cockpit, including working doppler radar and computer.

b) Tool kit with fuses and bulbs

c) Stopwatch - 2

d) 410B VTVM Vacuum Tube Voltmeter

e) 260 VOM Volt Ohmmeter

f) 545B Oscilloscope

g) 5245L Electronic Counter and Plug-Ins

h) TV2 Tube Tester

i) TS-148 Radar Test Set

j) 803 Differential VTVM

k) 200CD Audio Oscillator

l) URM-25D Signal Generator

m) TS-1100/U Test Set, Transistor

n) CMA-544 Doppler Simulator

o) CMA-546 Doppler Generator

p) 3322-900 Computer Cards Tester

q) 3322-902 Computer Drives Tester

r) 3322-905 Navigational Tester

s) 3322-901 Tester Computer Relay Chassis

t) SG-299 B/U Signal Generator

u) Kay Sweep Generator

v) TO 1C-141A-2-8

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) Answer any questions, then tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures."

d) Follow the subject's procedures and fill out evaluation sheet during the test.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section XVI (pg 16-1), then go to Operational Checkout, pg 16-3 (change 12).

b) Fault Symptom: On Step 16-7/g, distance-to-go does not decrease.

c) Go to Troubleshooting section 16-9.

d) When subject finds solution, computer unit, end the test. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on console.

b) Open all circuit breakers on avionics panel.

c) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

d) Replace and remove parts.

PROBLEM NO. 4. Computer Cockpit

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

Setup Conditions for Computer and Radar Test Harness Panel

Wires connecting: B15 & B5, B4 & E10, E6 & D16, E7 & D15, E11 & E16

Settings:

115 Vac - ON

Drift Angle - ON

Comp. Reference Track - IN

Heading Track Simulator - Int

Smooth Sea - OFF

28 Vdc - ON

115 V 400 cps - ON

28 Vdc - ON

26 Vac Exc - Int

Terrain Switch - Land

Synchro Zero - Rough Zero

Synchro Selector - OFF

Reference Synchro - Zero

Meter -Δ115V 400 cps

I.F. Gain - Full to Right

Test - OFF

Signal Selector - OFF

WORK ORDER

Troubleshoot malfunctioning AN/ASN-35 Navigational Computer.

I. Problem No. 5: Radar Bench - Crystal Y6701 in Frequency-Tracker. Troubleshoot to Subassembly - Frequency Mixer.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) Radar Set as per TO 12P5-2-APN 147-MSIM-5 (Page 1-1).

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter and frequency tracker assemblies.

d) Pull out interlocks.

e) Secure all connecting cables on setup.

f) Insert problem.

1) Locate frequency mixer subassembly on tracker chassis.

2) Locate crystal Y01 on mixer subassembly.

3) Remove good crystal and replace with defective crystal.

IV. Support Materials Required

a) Bench Test Mock-Up, AN/APN-147

b) Shorting Connectors

c) Doppler Test Kit, CMA-541/T(H)

d) VOM, Simpson-260 or PSM-6

e) Tool Kit

f) RF Signal Generator, AN/URM-250

g) Oscilloscope, Tektronix 545B

h) FPTA: TO 12P5-2APN-147-TS-3

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test, follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP" when time is up, unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section 1 (page 1-1).

b) Start checkout at Step 1 (page 1-3).

c) Note: On Steps 7 through 11, power supply tolerances may be greater than noted. Tell subject to continue if he questions these values.

d) Note: On Step 14, tell subject to set Synchro Zero dial to Rough Zero; there is no OFF setting.

e) Fault Symptom: On Step 53, a 2 kHz waveform cannot be obtained. Subject should say to replace frequency mixer--if so, problem is solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 5. Radar Bench

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Prepare for checkout					
Check power supply					
Check lights and blower					
Check slewing					
Check AGC alignment					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 5: Radar Bench - Crystal Y6701 in Frequency-Tracker. Troubleshoot to Subassembly - Frequency Mixer.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) Radar Set as per Section II, 206 of LTTA Manual for Radar Set.

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter and frequency tracker assemblies.

d) Pull out interlocks.

e) Secure all connecting cables on setup.

f) Insert problem.

1) Locate frequency mixer subassembly on tracker chassis.

2) Locate crystal Y01 on mixer subassembly.

3) Remove good crystal and replace with defective crystal.

IV. Support Materials Required

a) Bench Test Mock-Up, AN/APN-147

b) VOM, Simpson-260 or PSM-6

c) RF Signal Generator, AN/URM-250

d) Doppler Test Kit, CMA-541/T(H)

e) Oscilloscope, Tektronix 545B

f) Tool Kit

g) Shorting Connectors

h) LTTA: TO 12P5-2APN-147-TS-1

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test, follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP" when time is up, unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section 6-1 in LTTA Manual (page 6-1).

b) Start bench checkout at Section 6-6 (page 6-2).

c) Note: On Step 6-8/4, voltages may be slightly over tolerances given. Tell subject to continue if he questions these readings.

d) Fault Symptom: On Step 6-9/7, a 2 kHz sine wave cannot be obtained on oscilloscope. Subject should branch to Figure 6-12 (page 6-32).

e) Fault Symptom: Cannot obtain a 6 Vp-p 2kHz sine wave at pin 6 of vacuum tube V02. Subject should elect to replace frequency mixer. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 5. Radar Bench

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
6-7 Manual ground-speed and drift slew					
Power control and distribution					
Doppler detection					
Figure 6-12					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 5: Radar Bench - Crystal Y6701 in Frequency-Tracker. Troubleshoot to Subassembly - Frequency Mixer.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) Radar Set as per Section II, 206 of LTTA Manual for Radar Set.

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter and frequency tracker assemblies.

d) Pull out interlocks.

e) Secure all connecting cables on setup.

f) Insert problem.

1) Locate frequency mixer subassembly on tracker chassis.

2) Locate crystal Y01 on mixer subassembly.

3) Remove good crystal and replace with defective crystal.

IV. Support Materials Required

a) Bench Test Mock-Up, AN/APN-147

b) Tool Kit

c) 410B VTVM Vacuum Tube Voltmeter

d) 260 VOM Volt Ohmmeter

e) 545B Oscilloscope

f) 5245L Electronic Counter and Plug-Ins

g) TV2 Tube Tester

h) TS-148 Radar Test Set

i) 803 Differential VTVM

j) 200CD Audio Oscillator

k) URM-25D Signal Generator

l) TS-1100/U Test Set, Transistor

m) CMA-544 Doppler Simulator

n) CMA-546 Doppler Generator

o) 3322-900 Computer Cards Tester

p) 3322-902 Computer Drives Tester

q) 3322-905 Navigational Tester

r) 3322-901 Tester Computer Relay Chassis

s) SG-299 B/U Signal Generator

t) Kay Sweep Generator

u) TO 12P5-2APN147-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test, follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP" when time is up, unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section IX, pg 9-1, Table 9-1.

b) Go to pg 9-4, Table 9-2; start at Step 1.

c) Fault Symptom: On Step 2, the signal out will not be between 6.5 and 10 V rms at TP 6701.

d) Go to pg 9-181, para. 9-128; when he gets to para. 69, he should know that the frequency mixer is bad. End test. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 5. Radar Bench

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

WORK ORDER

Troubleshoot malfunctioning Radar Frequency Tracker down to faulty subassembly.

I. Problem No. 6: Computer Bench - Transistor Q2105 on Triple Binary Card.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section I of FPTA - TO 5N1-3-MSIM-6.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator, and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Give already defective board to subject.

IV. Support Materials Required

a) Bench test mock-up, AN/ASN-35

b) Oscilloscope, Tektronix 545B

c) Computer card tester, CMC3322-900

d) VOM, Simpson-260 or PSM-6

e) FPTA: TO tN1-3-TS-5

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During tests follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP" when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section 5 (pg 5-1).

b) Start checkout at Step 1 (pg 5-2).

c) Fault Symptom: On Step 7, waveform was the same as picture B.

d) Branch to Step 21 (pg 5-6).

e) Fault found on Step 22. Subject should say that transistor Q2105 (Q2005) is bad. Problem found. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 6. Computer Bench

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Check out and trouble-shoot triple binary component board assy					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 6: Computer Bench - Transistor Q2105 on Triple Binary Card.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASM-35 navigational computer mock-up as per Section II of LTTA Manual - TO 5N1-3-8-2-TS-1.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Give already defective board to subject.

IV. Support Materials Required

a) Bench test mock-up, AN/ASN-35.

b) Oscilloscope, Tektronix 545B.

c) Printed circuit board extension, 3450-048.

d) VOM, Simpson-260 or PSM-6.

e) LTTA: TO 5N1-3-8-2-TS-1.

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During tests follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP" when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section 4-79 (pg 4-110).

b) Fault Symptom: On Step 4-79/6C, 100 Hz frequency is not found.

c) Go to Troubleshooting Cross-Reference Table 4-10. Subject should find component of flip-flop Q05-Q06. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 6. Computer Bench

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Bench checkout for triple binary (pg 4-111)					
Troubleshooting for triple binary (pg 4-111)					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 6: Computer Bench - Transistor Q2105 on Triple Binary Card.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section IV of TO 5N1-3-8-2 page 6-1, 6-6.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator, and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Give already defective board to subject.

IV. Support Materials Required

a) Bench mock-up, AN/ASN-35

b) 410B VTVM Vacuum Voltmeter

c) 260 VOM Volt Ohmmeter

d) 545B Oscilloscope

e) 5245L Electronic Counter and Plug-Ins

f) 803 Differential VTVM

g) 200CD Audio Oscillator

h) TS-1100/U Test Set, Transistor

i) 3322-900 Computer Cards Tester

j) 3322-902 Computer Drives Tester

k) 3322-905 Navigational Tester

1) 3322 901 Tester Computer Relay Chassis

m) SG-299 B/U Signal Generator

n) TO 5N1-3-8-2

o) TO 33D7-3-37-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN trouble-shooting procedures." Start stopwatch when subject turns the page.

d) During tests follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP" when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

There is no specific procedure described in TO 5N1-3-8-2 "Computer Set, Navigational AN/ASN-35" or in TO 33D7-3-37-2 "Tester Computer Cards." Subject establishes his own troubleshooting strategy.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 6. Computer Bench

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

WORK ORDER

Troubleshoot malfunctioning Computer Triple Binary Card down to faulty component.

I. Problem No. 7: Radar Bench - Modulator in Receiver-Transmitter.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) mock-up as per TO 12P5-2APN-147-MSIM-5 (pg 1-1).

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter (R-T) and frequency tracker.

d) Pull out interlocks on both assemblies.

e) Secure all connecting cables.

f) Insert problem.

1) Find modulator subassembly on side of R-T chassis.

2) Remove cover from modulator and find filter FL8101.

3) Unsolder wire connecting to pin 4 of filter.

4) Reinstall modulator cover.

IV. Support Materials Required

a) Bench test mock-up, AN/APN-147

b) Stopwatch - 2

c) FPTA: TO 12P5-2APN147-TS-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, reading the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start on Section I (pg 1-1).

b) Start checkout at Step 1 (pg 1-3).

c) Fault Symptom: On Step 19 (pg 1-5) system will not lock on.

d) Go to Malfunction No. 4 (pg 1-10).

e) On Step 3 (pg 1-10) subject should say to remove modulator. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 7. Radar Bench

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Prepare for checkout					
Check power distribution					
Peak simulator meter					
Read test panel					
Check lock-on and acquire					
Troubleshoot malfunction No. 4					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

I. Problem No. 7: Radar Bench - Modulator in Receiver-Transmitter.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) mock-up as per Section II, 2-6 of LTTA Manual for Radar Set.

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter (R-T) and frequency tracker.

d) Pull out interlocks on both assemblies.

e) Secure all connecting cables.

f) Insert problem.

1) Find modulator subassembly on side of R-T chassis.

2) Remove cover from modulator and find filter FL8101.

3) Unsolder wire connecting to pin 4 of filter.

4) Reinstall modulator cover.

IV. Support Materials Required

a) Bench test mock-up, AN/APN-147

b) RF signal generator, AN/URM-25D

c) Oscilloscope, Tektronix 545B

d) Doppler test kit, CMA-541/T(H)

e) LTTA: TO 12P5-2APN 147-TS-1

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, reading the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start on Section 5 (pg 5-1).

b) Start checkout at Step 5-6 (pg 5-2).

c) Fault Symptom: On Step 5-6/17, subject should discover that system will not lock on.

d) Go to Figure 5-6 (pg 5-16) and begin logic tree.

e) Fault Symptom: Waveform at point J03 on modulator is not as shown in diagram. Subject should say to replace modulator. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Methods

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

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EVALUATION OF THREE TYPES OF TECHNICAL DATA FOR TROUBLESHOOTING--ETC(U)
SEP 76 N R POTTER, P R HUBBERT, J V LANDOLFI F33615-75-C-5103
AFHRL-TR-76-74(3)
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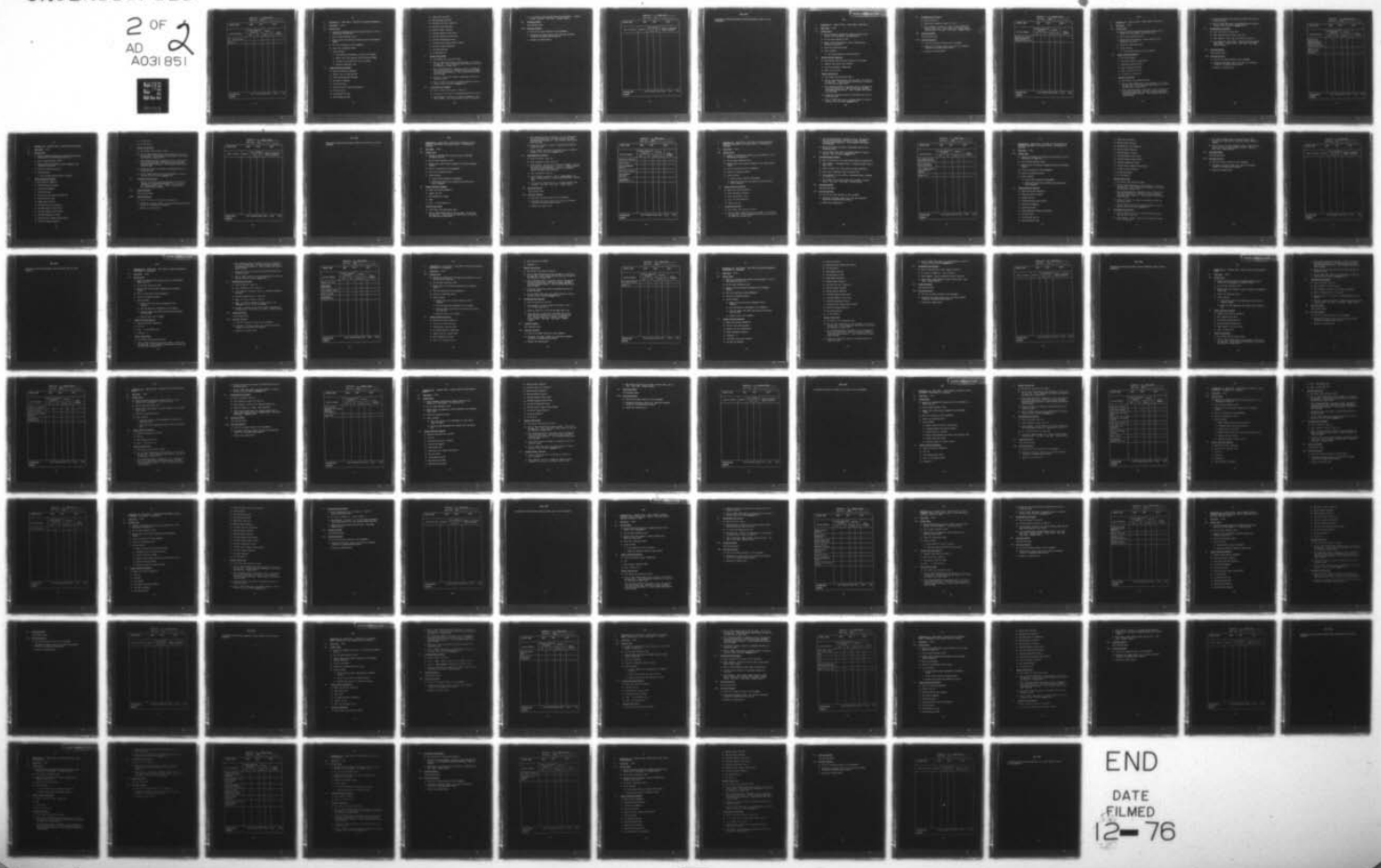

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PROBLEM NO. 7. Radar Bench

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
5-6. Bench checkout					
Figure 5-6					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 7: Radar Bench - Modulator in Receiver-Transmitter.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) mock-up as per Section II, 2-6 of LTTA Manual for Radar Set.

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter (R-T) and frequency tracker.

d) Pull out interlocks on both assemblies.

e) Secure all connecting cables.

f) Insert problem.

1) Find modulator subassembly on side of R-T chassis.

2) Remove cover from modulator and find filter FL8101.

3) Unsolder wire connecting to pin 4 of filter.

4) Reinstall modulator cover.

IV. Support Materials Required

a) Bench test mock-up, AN/APN-147

b) Doppler test kit, CMA-541/T(H)

c) 410B VTVM Vacuum Tube Voltmeter

d) 260 VOM Volt Ohmmeter

e) 545B Oscilloscope

f) 5245L Electronic Counter and Plug-Ins

g) TV2 Tube Tester

h) TS-148 Radar Test Set

i) 803 Differential VTVM

j) 200CD Audio Oscillator

k) URM-25D Signal Generator

l) TS-1100/U Test Set, Transistor

m) CMA-544 Doppler Simulator

n) CMA-546 Doppler Generator

o) 3322-900 Computer Cards Tester

p) 3322-902 Computer Drives Tester

q) 3322-905 Navigational Tester

r) 3322-901 Tester Computer Relay Chassis

s) SG-299 B/U Signal Generator

t) Kay Sweep Generator

u) TO 12P5-2APN147-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, reading the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section VIII, pg 8-1, Table 8-1.

b) Go to pg 8-7 and start R-T troubleshooting chart on Step 1.

c) Fault Symptom: On Step 3, no lock-on is obtained. Go to Step 10 where 1 Vp-p 2 kHz sine wave cannot be obtained.

d) Go to Step 11, where subject should check modulator. Problem solved. End test. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 7. Radar Bench

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

WORK ORDER

Troubleshoot malfunctioning Radar Receiver-Transmitter down to faulty subassembly.

I. Problem No. 8: Computer Bench - Diode CR1203 on NPN Card.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section II of LTTA Manual - TO 5N1-38-2TS-1.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Give already defective board to subject.

IV. Support Materials Required

a) Oscilloscope 545B with Type CA plug-in and 10X probe

b) Computer card tester, CMC 3322-900

c) Volt-ohm millimeter, Simpson-260

d) FPTA: TO 5N1-3-TS-5

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During tests follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP" when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start on page 3-1.

b) Start bench checkout on page 3-2, Step 1.

c) Fault Symptom: On page 3-3, Step 17, diode CR1203 (21) does not check good. Subject should say replace CR1203. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 8. Computer Bench

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Checkout and trouble-shoot NPN multiar component board assy					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 8: Computer Bench - Diode CR1203 on NPN Card.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section II of LTTA Manual - TO 5N1-3-8-2-TS-1.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Give already defective board to subject.

IV. Support Materials Required

a) Test bench computer

b) Volt-ohm millimeter, Simpson-260

c) Frequency counter HP 5345L

d) Audio oscillator HP 200CD

e) LTTA: TO 5N1-3-8-2-TS-1

f) TO 5N1-3-8-2 Figure 7-28

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During tests follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP" when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start on Section 4-34 (pg 4-64).

b) Start bench checkout on Step 1 (pg 4-64).

c) Fault Symptom: Step 8 (pg 4-64) does not check out.

d) Go to page 4-66, Step 4-35/8. Subject should say replace diode CR1203. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 8. Computer Bench

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Section 4-34 Bench checkout procedure for NPN multiar 3318-480 (1200) pretest setup					
Section 4-35 Bench checkout procedure					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 8: Computer Bench - Bad NPN Card Diode CR1203.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section IV of TO 5N1-3-8-2 page 6-1, 6-6.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator, and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Give already defective board to subject.

IV. Support Materials Required

a) Bench mock-up, AN/ASN-35

b) 410B VTVM Vacuum Voltmeter

c) 260 VOM Volt Ohmmeter

d) 545B Oscilloscope

e) 5245L Electronic Counter and Plug-Ins

f) 803 Differential VTVM

g) 200CD Audio Oscillator

h) TS-1100/U Test Set, Transistor

i) 3322-900 Computer Cards Tester

j) 3322-902 Computer Drives Tester

k) 3322-905 Navigational Tester

1) 3322-901 Tester Computer Relay Chassis

m) SG-299 B/U Signal Generator

n) TO 5N1-3-8-2

o) TO 33D7-3-37-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During tests follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP" when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

There is no specific procedure described in TO 5N1-3-8-2 "Computer Set, Navigational AN/ASN-35" or in TO 33D&-3-37-2 "Tester Computer Cards". Subject establishes his own troubleshooting strategy.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 8. Computer Bench

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: |_|Yes |_|No

Remarks:

WORK ORDER

Troubleshoot malfunctioning Computer NPN multiar Card down to faulty component.

I. Problem No. 9: Radar Bench - Relay K01 in Electronic Control Amplifier Subassembly of Frequency Tracker. Troubleshoot to component.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) mock-up as per TO 12P5-2APN 147-MSIM-5 (pg 1-1).

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter (R-T) and frequency tracker.

d) Pull out interlocks on both assemblies.

e) Secure all connecting cables.

f) Insert problem.

1) Locate control amplifier subassembly.

2) Remove good relay K01 and replace with bad K01 with pin 14 disabled.

IV. Support Materials Required

a) Bench Test Mock-Up AN/APN-147

b) Doppler Test Kit

c) VOM Simpson-260 or PSM-6

d) VTVM

e) FPTA: TO 12P5-2APN147-TS-3

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section I (pg 1-1).

b) Start checkout on Step 1 (pg 1-3).

c) Fault Symptom: On Step 23, G/S will not increase. S should go to pg 1-30, malfunction No. 9, Step 9. S should replace electronic control amplifier. Tell S to troubleshoot control amp down to bad component.

d) Start at Section 8, pg 8-1.

e) Start checkout on page 8-3, Step 1. Fault Symptom: On Step 9, reading does not increase when switch is in increase mode.

f) Go to pg 8-14, malfunction No. 4. S should replace relay on Step 5. End test. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 9. Radar Bench

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Prepare for checkout					
Check relays					
Check groundspeed detector					
Check drift detector					
Check magnetic modulator					
Troubleshoot Malfunction No. 11					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 9: Radar Bench - Relay K01 in Electronic Control Amplifier Subassembly of Frequency Tracker. Troubleshoot to component.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) mock-up as per Section II, 2-6 of LTTA Manual for Radar Set.

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter (R-T) and frequency tracker.

d) Pull out interlocks on both assemblies.

e) Secure all connecting cables.

f) Insert problem.

1) Locate control amplifier subassembly.

2) Remove good relay K01 and replace with bad K01 with pin 14 disabled.

IV. Support Materials Required

a) Bench Test Mock-Up AN/APN-147

b) VTVM, Multimeter TS-5050/U

c) VOM, Simpson-260 or PSM-6

d) LTTA: TO 12P5-2APN147-TS-1

e) Doppler Test Kit

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section VI, then begin bench checkout on Section 6-6.

b) Fault Symptom: Groundspeed doesn't increase at proper rate on Step 6-7/6c.

c) Branch to Figure 6-8, find problem in control amplifier.

d) Start control amplifier check on Section 6-48.

e) Fault Symptom: On Step 6-52/5b, groundspeed doesn't increase at correct rate.

f) Go to Figure 6-42 and find problem in relay K01. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 9. Radar Bench

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
6-7 Manual ground-speed and drift slew					
6-48 Electronic Control Amplifier					
6-52 Manual Ground-speed and Drift Slewing					
Figure 6-42					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 9: Radar Bench - Relay K01 in Electronic Control Amplifier Subassembly of Frequency Tracker. Troubleshoot to component.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) mock-up as per Section II, 2-6 of LTTA Manual for Radar Set.

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter (R-T) and frequency tracker.

d) Pull out interlocks on both assemblies.

e) Secure all connecting cables.

f) Insert problem.

1) Locate control amplifier subassembly.

2) Remove good relay K01 and replace with bad K01 with pin 14 disabled.

IV. Support Materials Required

a) Bench Test Mock-Up AN/APN-147

b) VTVM, Multimeter TS-5050/U

c) Doppler Test Kit

d) 410B VTVM Vacuum Tube Voltmeter

e) 260 VOM Volt Ohmmeter

f) 545B Oscilloscope

g) 5245L Electronic Counter and Plug-Ins

h) TV2 Tube Tester

i) TS-148 Radar Test Set

j) 803 Differential VTVM

k) 200CD Audio Oscillator

l) URM-25D Signal Generator

m) TS-1100/U Test Set, Transistor

n) CMA-544 Doppler Simulator

o) CMA-546 Doppler Generator

p) 3322-900 Computer Cards Tester

q) 3322-902 Computer Drives Tester

r) 3322-905 Navigational Tester

s) 3322-901 Tester Computer Relay Chassis

t) SG-299 B.U Signal Generator

u) Kay Sweep Generator

v) TO 12P5-2APN147-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section IX, pg 9-1, then begin Tracker Trouble-shooting Chart on pg 9-12.

b) Fault Symptom: On Step 7 (pg 9-15), G/S doesn't increase at 5 ± 0.5 knots/sec.

c) Go to Step 8, then to Step 10, then to Step 13, then Step 15, when S should start electronic control amplifier checkout.

d) Start on Step 1, pg 9-90, proceed to Step 2, Step 4, Step 5, Step 6, and Step 7, where problem is solved. End test. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 9. Radar Bench

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

WORK ORDER

Troubleshoot malfunctioning Radar Frequency Tracker down to faulty component.

I. Problem No. 10: Radar Bench - Tube V6403 in Receiver-Transmitter. Troubleshoot to subassembly.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) mock-up as per TO 12P5-2APN147-MSIM-5 (pg 1-1).

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter and frequency tracker.

d) Pull out interlocks on both assemblies.

e) Secure all connecting cables.

f) Insert problem.

1) Remove cover from receiver-transmitter (R-T) assembly.

2) Find IFB amplifier subassembly on R-T assembly.

3) Find and remove tube V6403 from IFB unit and replace with bad tube.

4) Replace cover on R-T assembly.

IV. Support Materials Required

a) Bench test mock-up, AN/APN-147

b) Tool kit

c) FPTA: TO 12P5-2APN147-TS-2

d) Stopwatch - 2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section I (pg 1-3).

b) Start checkout at Step 1 (pg 1-3).

c) Fault Symptom: On Step 14 (pg 1-4), IFB meter reading is not good.

d) Branch to Manfunction No. 4 (pg 1-10).

e) Note: On Step 1, branch to Step 17.

f) Note: On Step 18, diagram (5) should point to IFA subassembly and (6) to IFB subassembly.

g) On Step 21, subject should say to replace IFB amplifier. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 10. Radar Bench

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Prepare for check					
Check power distribution					
Peak simulator meter					
Read test panel					
Troubleshoot malfunction No. 4					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 10: Radar Bench - Tube V6403 in Receiver-Transmitter. Troubleshoot to subassembly.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) mock-up as per Section II, 2-6 of LTTA Manual for Radar Set.

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter and frequency tracker.

d) Pull out interlocks on both assemblies.

e) Secure all connecting cables.

f) Insert problem.

1) Remove cover from receiver-transmitter (R-T) assembly.

2) Find IFB amplifier subassembly on R-T assembly.

3) Find and remove tube V6403 from IFB unit and replace with bad tube.

4) Replace cover on R-T assembly.

IV. Support Materials Required

a) Bench test mock-up, AN/APN-147

b) Tool kit with shorting wires

c) Oscilloscope, Tektronix 545B

d) RF signal generator, AN/URM-25D

e) Doppler test kit, CMA-541/T(H)

f) VOM, Simpson-260 or PSM-6

g) LTTA: TO 12P5-2APN 147-TS-1

h) VTVM, Multimeter TS-5050/U

i) Stopwatch - 2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section 5-1 (pg 5-1).

b) Fault Symptom: On Step 5-6/18b, AGC voltage is not -5 ± 1 V at test point TP 01.

c) Branch to Figure 5-7 (pg 5-18) and begin logic tree.

d) Fault Symptom: On jack J04, the forward and reverse resistance ratio between pins 1 and 7 is greater than 10:1. Subject should say to replace IFB amplifier. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 10. Radar Bench

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
5-6 Bench checkout					
Figure 5-7					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 10: Radar Bench - Tube V6403 in Receiver-Transmitter. Troubleshoot to subassembly.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) mock-up as per Section II, 2-6 of LTTA Manual for Radar Set.

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter and frequency tracker.

d) Pull out interlocks on both assemblies.

e) Secure all connecting cables.

f) Insert problem.

1) Remove cover from receiver-transmitter (R-T) assembly.

2) Find IFB amplifier subassembly on R-T assembly.

3) Find and remove tube V6403 from IFB unit and replace with bad tube.

4) Replace cover on R-T assembly.

IV. Support Materials Required

a) Bench test mock-up, AN/APN-147

b) Tool kit with shorting wires

c) Doopler test kit, CMA-541/T(H)

d) VTVM, Multimeter TS-5050/U

e) Stopwatch - 2

f) 410B VTVM Vacuum Tube Voltmeter

g) 260 VOM Volt Ohmmeter

h) 545B Oscilloscope

i) 5245L Electronic Counter and Plug-Ins

j) TV2 Tube Tester

k) TS-148 Radar Test Set

l) 803 Differential VTVM

m) 200CD Audio Oscillator

n) URM-25D Signal Generator

o) TS-1100/U Test Set, Transistor

p) CMA-544 Doppler Simulator

q) CMA-546 Doppler Generator

r) 3322-900 Computer Cards Tester

s) 3322-902 Computer Drives Tester

t) 3322-905 Navigational Tester

u) 3322-901 Tester Computer Relay Chassis

v) SG-299 B/U Signal Generator

w) Kay Sweep Generator

x) TO 12P5-2APN147-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section VIII, pg 8-1, Table 8-1 and 8-3.

b) Go to pg 8-7, Table 8-3. Start at Step 1.

c) Fault Symptom: May be discovered in Step 9, pg 8-14.

d) When subject finds problem, bad IFB, end the test. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 10. Radar Bench

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

WORK ORDER

Troubleshoot malfunctioning Radar Receiver-Transmitter down to faulty subassembly.

I. Problem No. 11: Computer Bench - Resistor R301 in Track Resolver Drive.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section II of LTTA Manual - TO 5N1-3-8-2-TS-1.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator, and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Find track resolver drive subassembly on front end of computer chassis.

2) Remove the TRD subassembly and replace with a defective one.

IV. Support Materials Required

a) Computer bench mock-up, AN/ASN-35

b) VOM, Simpson-260 or PSM-6

c) Oscilloscope, Tektronix 545-D

d) Resolver bridge balancing jig

e) Tags (labels) for circuit boards

f) FPTA: TO 5N1-3-TS-12

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During tests follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP" when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start on Section I (pg 1-1).

b) Start checkout at Step 1 (pg 1-4).

c) Fault Symptom: *On Step 47 null cannot be obtained.*

d) Branch to Malfunction No. 17 (pg 1-82).

e) Note: On Step 2, tell subject to assume NPN multiar card is good.

f) On Step 2, subject should say to replace track resolver drive. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 11. Computer Bench

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Prepare for checkout					
Initiate checkout					
Check resolver bridge balance					
Troubleshoot malfunction No. 17					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 11: Computer Bench - Resistor R301 in Track Resolver Drive.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section II of LTTA Manual - TO 5N1-3-8-2-TS-1.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator, and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Find track resolver drive subassembly on front end of computer chassis.

2) Remove the TRD subassembly and replace with a defective one.

IV. Support Materials Required

a) Resolver balancing jig, 3173-918

b) Tool kit

c) VOM, Simpson-260 or PSM-6

d) LTTA: TO 5N1-3-8-2-TS-1

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During tests follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP" when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start on Section 4 (pg 4-1).

b) Start Checkout at Step 4-4/1 (pg 4-2).

c) Fault Symptom: On Step 4-4/3, voltage exceeds 6 mV.

d) Branch to Figure 4-1. Note: Check resistors.

e) After going through Logic Tree, subject should say to replace track resolver drive. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 11. Computer Bench

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Bench checkout procedure for overall NAV/Comp. CP-622/ASN-35					
Logic Tree					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 11: Computer Bench - Resistor R301 in Track Resolver Drive.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section II of LTTA Manual - TO 5N1-3-8-2-TS-1.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator, and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Find track resolver drive subassembly on front end of computer chassis.

2) Remove the TRD subassembly and replace with a defective one.

IV. Support Materials Required

a) Resolver balancing jig, 3173-918

b) Tool kit

c) 410B VTVM Vacuum Tube Voltmeter

d) 260 VOM Volt Ohmmeter

e) 545B Oscilloscope

f) 5245L Electronic Counter and Plug-Ins

g) TV2 Tube Tester

h) TS-148 Radar Test Set

i) 803 Differential VTVM

j) 200CD Audio Oscillator

k) URM-25D Signal Generator

l) TS-1100/U Test Set, Transistor

m) CMA-544 Doppler Simulator

n) CMA-546 Doppler Generator

o) 3322-900 Computer Cards Tester

p) 3322-902 Computer Drives Tester

q) 3322-905 Navigational Tester

r) 3322-901 Tester Computer Relay Chassis

s) SG-299 B/U Signal Generator

t) Kay Sweep Generator

u) TO 5N1-3-8-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During tests follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP" when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section VII (pg 7-5) then go to Figure 7-4, pg 7-6 (change 4).

b) Fault Symptom: On Step 1, Signal Out signal will not decrease to 6 mv-rms or 17 mv peak to peak or less.

c) When subject finds correct problem, resistor R301, end the test. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 11. Computer Bench

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

WORK ORDER

Troubleshoot malfunction computer unit down to faulty subassembly.

I. Problem No. 12: Radar Bench - Diodes CR7601 and CR7602 in Side A of Antenna. Troubleshoot to components.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) mock-up as per TO 12P5-2APN-147-MSIM-5 (pg 1-1).

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter and frequency tracker.

d) Pull out interlocks on both assemblies.

e) Secure all connecting cables.

f) Insert problem.

1) Remove latches from side A diode holder.

2) Disengage holder from antenna chassis.

3) Unscrew caps (2) on holder.

4) Remove crystal diodes and replace with defective ones.

5) Replace caps into holder.

6) Reinstall holder to antenna chassis.

IV. Support Materials Required

a) Bench test mock-up, AN/APN-147

b) Tool kit

c) VOM, Simpson-260 or PSM-6

d) FPTA: TO 12P5-2APN-147-TS-4

e) Stopwatch - 2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section 2 (pg 2-1).

b) Start checkout at Step 1 (pg 2-3).

c) Fault Symptom: On Step 30 (pg 2-6) indicator reading does not stay between 198 and 202. Antenna will not lock on.

d) Go to Malfunction No. 15 (pg 2-36).

e) On Step 6, subject should say to replace crystal diodes. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 12. Radar Bench

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Prepare for checkout					
Check drift slewing					
Check rotor and time meter					
Check drift reversing circuit					
Check pitch slewing					
Check smooth sea operation					
Check if disabling circuits					
Check lock-on					
Troubleshoot malfunction No. 15					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 12: Radar Bench - Diodes CR7601 and CR7602 in Side A of Antenna. Troubleshoot to components.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) mock-up as per Section II, 2-6 of LTTA Manual for Radar Set.

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter and frequency tracker.

d) Pull out interlocks on both assemblies.

e) Secure all connecting cables.

f) Insert problem.

1) Remove latches from side A diode holder.

2) Disengage holder from antenna chassis.

3) Unscrew caps (2) on holder.

4) Remove crystal diodes and replace with defective ones.

5) Replace caps into holder.

6) Reinstall holder to antenna chassis.

IV. Support Materials Required

a) Bench test mock-up, AN/APN-147

b) Oscilloscope, Tektronix 545B

c) Tool kit

d) Stopwatch

e) Inclinometer

f) VTVM Multimeter, TS-5050/U

g) LTTA: 12P5-2APN-147-TS-1

h) LTTA: TO 12P5-2APN 147-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section 4 (pg 4-1).

b) Start checkout on Step 4-5 (pg 4-1.).

c) Note: On Step 4-5/17 tell subject to assume waveforms at test points TP82 and TP83 are OK, if they are slightly off from the diagram.

d) On Step 4-5/23 crystal diodes should be found defective by subject (no test kit needed). Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 12. Radar Bench

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
4-5 Bench Checkout					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 12: Radar Bench - Diodes CR7601 and CR7602 in Side A of Antenna. Troubleshoot to components.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) mock-up as per Section II, 2-6 of LTTA Manual for Radar Set.

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter and frequency tracker.

d) Pull out interlocks on both assemblies.

e) Secure all connecting cables.

f) Insert problem.

1) Remove latches from side A diode holder.

2) Disengage holder from antenna chassis.

3) Unscrew caps (2) on holder.

4) Remove crystal diodes and replace with defective ones.

5) Replace caps into holder.

6) Reinstall holder to antenna chassis.

IV. Support Materials Required

a) Bench test mock-up, AN/APN-147

b) Tool kit

c) Stopwatch

d) Inclinometer

e) 410B VTVM Vacuum Tube Voltmeter

f) 260 VOM Volt Ommeter

g) 545B Oscilloscope

h) 5245L Electronic Counter and Plug-Ins

i) TV2 Tube Tester

j) TS-148 Radar Test Set

k) 803 Differential VTVM

l) 200CD Audio Oscillator

m) URM-25D Signal Generator

n) TS-1100/U Test Set, Transistor

o) CMA-544 Doppler Simulator

p) CMA-546 Doppler Generator

q) 3322-900 Computer Cards Tester

r) 3322-902 Computer Drives Tester

s) 3322-905 Navigational Tester

t) 3322-901 Tester Computer Relay Chassis

u) SG-299 B/U Signal Generator

v) Kay Sweep Generator

w) TO 12P5-2APN147-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section VII, pg 7-1, Table 7-1. See T7-2 Antenna Maintenance Chart.

b) Go to pg 7-3, Table 7-2. Start at Step 1.

c) Fault Symptom: In Step 8, pg 7-4, while making microwave crystal performance check, the crystals should check bad.

d) When subject finds problem, end the test. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 12. Radar Bench

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

WORK ORDER

Troubleshoot malfunctioning antenna assembly down to faulty component.

I. Problem No. 13: Computer Bench - Switch SW5405 in Control Indicator (10-mile warning light fails to light when control indicator reads 010 ± 1 NM).

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section II of LTTA Manual -

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Locate SW5405 on control indicator.

2) Substitute defective switch for good switch.

IV. Support Materials Required

a) Control indicators tester, CMC3322-910

b) VOM

c) RMS voltmeter, Model HP 3400A

d) FPTA: TO 5N1-3-TS-3

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at pg 1-6, Step 1.

b) Fault Symptom: ON light does not come on when counter indicates 010±001, Step 21, pg 1-8.

c) Go to pg 1-20, mafunction No. 12.

d) Fault Symptom: On Step 4 of malfunction 12, ohm reading is greater than 1 ohm; go to Step 10.

e) Step 10 indicates replace SW5405. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 13. Computer Bench

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Inspect control indicator					
Check counter assemblies					
Check torque transmitter continuity					
Set up control indicator's tester					
Check integral lighting					
Check OFF light					
Check AUTO-MAN-OFF switch					
Check 10 mile warning circuit					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 13: Computer Bench - Switch SW5405 in Control Indicator (10-mile warning light fails to light when control indicator reads 010 ± 1 NM).

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section II of LTTA Manual - TO 5N1-3-8-2-TS-1.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Locate SW5405 on control indicator.

2) Substitute defective switch for good switch.

IV. Support Materials Required

a) Computer bench mock-up, AN/ASN-35

b) ME6/U electronic voltmeter

c) Oscilloscope, Tektronix 545B

d) LTTA: TO 5N1-3-8-2-TS-1

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section 5-1 (pg 5-1).

b) Proceed through to Section 5-7 (pg 5-4).

c) Fault Symptom: Section 5-7/4, control warning light will not light when indicator reads 010 NM.

d) Go to Troubleshooting Cross-Reference Table 5-1 (pg 5-12); step failed. Replace SW5405. Trouble found. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 13. Computer Bench

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Track error angle computing synchro operation					
Readout operation					
Automatic stage switching operation					
10-mile warning indicator operation					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 13: Computer Bench - Switch SW5405 in Control Indicator (10-mile warning light fails to light when control indicator reads 010 ± 1 NM).

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section II of LTTA Manual - TO 5N1-3-8-2-TS-1.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Locate SW5405 on control indicator.

2) Substitute defective switch for good switch.

IV. Support Materials Required

a) Computer bench mock-up, AN/ASN-35

b) ME-6/U electronic voltmeter

c) 410B VTVM Vacuum Tube Voltmeter

d) 260 VOM Volt Ohmmeter

e) 545B Oscilloscope

f) 5245L Electronic Counter and Plug-Ins

g) TV2 Tube Tester

h) TS-148 Radar Test Set

i) 803 Differential VTVM

j) 200CD Audio Oscillator

k) URM-25D Signal Generator

l) TS-1100/U Test Set, Transistor

m) CMA-544 Doppler Simulator

n) CMA-546 Doppler Generator

o) 3322-900 Computer Cards Tester

p) 3322-902 Computer Drives Tester

q) 3322-905 Navigational Tester

r) 3322-901 Tester Computer Relay Chassis

s) SG-299 B/U Signal Generator

t) Kay Sweep Generator

u) TO 5N1-3-8-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section VIII, pg 8-1, para. 8-7, then go to Figure 8-1, pg 8-2 (Note: There is no check for finding this problem), para. 8-18 explains 10-mile warning switch.

b) When subject finds problem, SW5405 in control indicator, end the test. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 13. Computer Bench

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

WORK ORDER

Troubleshoot malfunctioning computer control indicator down to faulty component.

I. Problem No. 14: Radar Bench - Crystal Y6701 in Frequency Mixer. Troubleshoot from frequency mixer to crystal.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) as per TO 12P5-2APN-147-MSIM-5 (pg 1-1).

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter and frequency tracker assemblies.

d) Pull out interlocks.

e) Secure all connecting cables on setup.

f) Insert problem.

1) Locate frequency mixer subassembly on frequency tracker.

2) Locate crystal Y6701 on frequency mixer.

3) Replace good crystal with defective crystal.

IV. Support Materials Required

a) Bench test mock-up, AN/APN-147

b) VOM, Simpson-260

c) VTVM, 410B

d) RF signal generator, AN/URM-25D

e) Doppler test kit

f) FPTA: TO 12P5-2APN-147-TS-3

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at page 4-4, Step 1.

b) Step 9. Note: Cable referred to is in doppler test kit.

c) Step 13. Fault Symptom: Reading is less than 3.5 Vac.

d) Subject should say to replace Y6701 crystal. Problem solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 14. Radar Bench

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Make resistance checks					
Check crystal oscillator					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 14: Radar Bench - Crystal Y6701 in Frequency Mixer. Troubleshoot from frequency mixer to crystal.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) as per Section II, 2-6 of LTTA Manual for Radar Set.

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter and frequency tracker assemblies.

d) Pull out interlocks.

e) Secure all connecting cables on setup.

f) Insert problem.

1) Locate frequency mixer subassembly on frequency tracker.

2) Locate crystal Y6701 on frequency mixer.

3) Replace good crystal with defective crystal.

IV. Support Materials Required

a) Bench test mock-up, AN/APN-147

b) Doppler test kit

c) Oscilloscope, Tektronix 545B

d) Frequency counter, HP5345L

e) LTTA: TO 12P5-2APN-147-TS-1

f) LTTA: TO 12P5-2APN-147-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section 6-17 and go to 6-21 (pg 6-44).

b) Fault Symptom: In Section 6-21/4a, cannot obtain proper peak to peak voltage.

c) Refer to Cross Reference Index, Table 6-2 (pg 6-48).

d) If Step 6-21/4a failed, go to procedure Figure 6-20 (pg 6-50).

e) Fault Symptom: Cannot obtain proper voltage at TP01. Subject should say to replace Y6701 crystal. Problem Solved. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 14. Radar Bench

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
6-17 Freq. Mixer					
6-18					
6-19					
6-20					
6-21 Oscillator and Frequency Multiplier					
Table 6-2, Fig. 6-21					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 14: Radar Bench - Crystal Y6701 in Frequency Mixer. Troubleshoot from frequency mixer to crystal.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install one AN/APN-147(V) as per Section II, 2-6 of LTTA Manual for Radar Set.

b) Set all power switches to OFF.

c) Remove covers from receiver-transmitter and frequency tracker assemblies.

d) Pull out interlocks.

e) Secure all connecting cables on setup.

f) Insert problem.

1) Locate frequency mixer subassembly on frequency tracker.

2) Locate crystal Y6701 on frequency mixer.

3) Replace good crystal with defective crystal.

IV. Support Materials Required

a) Bench test mock-up, AN/APN-147

b) Doppler test kit

c) 410B VTVM Vacuum Tube Voltmeter

d) 260 VOM Volt Ohmmeter

e) 545B Oscilloscope

f) 5245L Electronic Counter and Plug-Ins

g) TV2 Tube Tester

h) TS-148 Radar Test Set

i) 803 Differential VTVM

j) 200CD Audio Oscillator

k) URM-25D Signal Generator

l) TS-1100/U Test Set, Transistor

m) CMA-544 Doppler Simulator

n) CMA-546 Doppler Generator

o) 3322-900 Computer Cards Tester

p) 3322-902 Computer Drives Tester

q) 3322-905 Navigational Tester

r) 3322-901 Tester Computer Relay Chassis

s) SG-299 B/U Signal Generator

t) Kay Sweep Generator

u) TO 12P5-2APN147-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Secion IX, pg 9-2, Table 9-1.

b) Go to pg 9-54, Table 9-4, and start at Step 1.

c) Fault Symptom: On Step 1, the oscilloscope should not display 25 ± 5 Vpp and the frequency should not be 99,824 ± 100 Hz.

d) When subject finds problem, Y6701, end the test. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 14. Radar Bench

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

WORK ORDER

Troubleshoot malfunctioning frequency mixer subassembly down to faulty component.

I. Problem No. 15: Computer Bench - Relay K4402 in Aux. Cross Track Indicator.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section II of LTTA Manual - TO 5N1-3-8-2-TS-1.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Locate relay K4402 in auxiliary cross track.

2) Replace good relay with defective relay.

IV. Support Materials Required

a) Control indicators tester, CMC3322-910

b) VOM

c) Feeler gauge

d) FPTA: TO 5N1-3-TS-3

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Step 1 (pg 2-2).

b) Step 20 (pg 2-4) Fault Symptom: Distance cross track counter does not indicate 100 LEFT. Go to Step 62 (pg 2-8).

c) Fault Symptom: Measurement on magnet assembly is OK. Go to Step 63, Which indicates to Replace K4402. Problem found. Test ends. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 15. Computer Bench

TEST TYPE: FPTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
Inspect auxiliary cross track control indicator					
Check distance cross track counter rotation					
Check R4401/R4402 continuity (initial)					
Set up control indicator's tester bench test mock-up					
Check integral lighting					
Check distance cross track counter operation					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 15: Computer Bench - Relay K4402 in Aux. Cross Track Indicator.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section II of LTTA Manual - TO 5N1-3-8-2-TS-1.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Locate relay K4402 in auxiliary cross track.

2) Replace good relay with defective relay.

IV. Support Materials Required

a) Bench mock-up, AN/ASN-35

b) LTTA: TO 5N1-3-8-2-TS-1

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start Section 6-1, Introduction (pg 6-1).

b) Section 6-4/3 Fault Symptom: Auxiliary cross track does not increase. Go to Troubleshooting Cross-Reference, Table 6-1 (pg 6-6).

c) Malfunction 6-3/4 finds faulty relay K4402. Problem solved. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 15. Computer Bench

TEST TYPE: LTTA

SUBJECT NAME	RANK	AFSN	DATE

Section Heading	Section Completed Correctly		Branched		Parts Consumed
	Yes	No	From	To	
6-4 Readout Operation					
Malfunction Cross-Reference 4-4/3					

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

I. Problem No. 15: Computer Bench - Relay K4402 in Aux. Cross Track Indicator.

II. Time Limit: 1 Hour

III. Pretest Setup

a) Install AN/ASN-35 navigational computer mock-up as per Section II of LTTA Manual - TO 5N1-3-8-2-TS-1.

b) Set all power switches to OFF.

c) Remove covers from computer, control indicator and auxiliary cross track.

d) Secure all connecting cables.

e) Insert problem.

1) Locate relay K4402 in auxiliary cross track.

2) Replace good relay with defective relay.

IV. Support Materials Required

a) Bench mock-up, AN/ASN-35

b) 410B VTVM Vacuum Voltmeter

c) 260 VOM Volt Ohmmeter

d) 545B Oscilloscope

e) 5245L Electronic Counter and Plug-Ins

f) TV2 Tube Tester

g) TS-148 Radar Test Set

h) 803 Differential VTVM

i) 200CD Audio Oscillator

j) URM-25D Signal Generator

k) TS-1100/U Test Set, Transistor

l) CMA-544 Doppler Simulator

m) CMA-546 Doppler Generator

n) 3322-900 Computer Cards Tester

o) 3322-902 Computer Drives Tester

p) 3322-905 Navigational Tester

q) 3322-901 Tester Computer Relay Chassis

r) SG-299 B/U Signal Generator

s) Kay Sweep Generator

t) TO 5N1-3-8-2

V. General Instructions

a) Give subject (S) instruction sheet.

b) Tell S, "Read instructions on the top sheet. Do not turn the page over. After reading the instructions, you may ask any questions you might have."

c) After answering subject's questions, tell S, "You may now turn the top sheet over, read the work order and BEGIN troubleshooting procedures." Start stopwatch when subject turns the page.

d) During test follow the subject's procedures and fill out evaluation sheet.

e) Tell S, "STOP," when time is up unless subject is close to solution--allow 15 minutes maximum extra.

VI. Troubleshooting Procedure

a) Start at Section X, pg 10-1, para. 10-7.

b) Go to Figure 10-1, pg 10-4, and do Steps 1 and 2.

c) Go to Figure 10-2, pg 10-5.

d) Fault Symptom: K4402 does not energize on Step 2, Figure 10-2, pg 10-5.

e) When subject finds problem, relay K4402, end the test. Stop timer. Dismiss subject.

VII. Evaluation Method

(See enclosed sheet)

VIII. Post-Test Recovery

a) Turn off all power switches on test equipment.

b) Disconnect all wires, cables, etc. that were installed during the troubleshooting procedure.

c) Replace any removed parts.

PROBLEM NO. 15. Computer Bench

TEST TYPE: TO

SUBJECT NAME	RANK	AFSN	DATE

Test or Section	Page No.	Test Checkout		Result or Solution (parts replaced)
		Yes	No	

Testing Time: Test Finished Within Time: ☐ Yes ☐ No

Remarks:

WORK ORDER

Troubleshoot malfunctioning auxiliary cross track indicator down to faulty component.